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Te Pou Rāhui Hanga Hou

CERTIFICATE

This certificate is issued in support of an application for Patent registration in a country outside New Zealand pursuant to the Patents Act 1953 and the Regulations thereunder.

I hereby certify that annexed is a true copy of the Provisional Specification as filed on 28 March 2002 with an application for Letters Patent number 518092 made by PULSE DATA INTERNATIONAL LIMITED.

Dated 1 April 2003.

PRIORITY DOCUMENT
SUBMITTED OR TRANSMITTED IN COMPLIANCE WITH RULE 17.1(a) OR (b)

Neville Harris

Neville Harris
Commissioner of Patents

518092

Intellectual Property
Office of N.Z.

28 MAR 2002

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NEW ZEALAND

PATENTS ACT, 1953

PROVISIONAL SPECIFICATION

Improved Low-Vision Video Magnifier

We, PULSE DATA INTERNATIONAL LIMITED, a company duly incorporated under the laws of New Zealand of 1 Expo Place, Bromley, Christchurch, New Zealand, do hereby declare this invention to be described in the following statement:

BACKGROUND OF THE INVENTION

Field of the Invention

This invention relates to a viewing device to enable people with low-vision to read printed material or view pictures and objects and in particular, but not solely relates to a device to capture a single high-resolution image of the source material and manipulate this image into other formats.

Summary of the Prior Art

Low vision is defined as a condition where ordinary eye glasses, lens implants or contact lenses cannot provide sharp sight. Low vision can be caused by a variety of eye problems. Macular degeneration, diabetic retinopathy, inoperable cataracts, and glaucoma are but a few of the conditions that cause low vision. Individuals with low vision find it difficult, if not impossible, to read small writing or to discern small objects without high levels of magnification. This can limit their ability to lead an independent life.

One method of providing greater magnification is the use of a Video Magnifier. Such devices use a camera to image an object that is to be viewed. Video images taken from the camera are continuously displayed on a visual display unit (VDU), at a sufficient level of magnification for the user. The low vision user can then use their remaining sight to its best advantage when viewing very small objects or writing.

An example of existing prior art is shown in Figure 1. It consists of three basic parts - a VDU 1, a head unit 2, and a base unit 3. The VDU 1 is mounted on the head unit 2, which is in-turn mounted above the base unit 3 using a vertical pillar 4. The VDU 1 may be of a cathode ray tube or a flat-panel screen with a liquid crystal display panel type. The source material is placed on the base unit 3 which consists of a base and a table 5 moveable on an X-Y axis. The X-Y table 5, moves on runners 6 and 7 in the horizontal directions X and Y to scan the source material past the field of view. Camera 8 is part of the head unit 2 and consists of mirror 11, zoom lens 9 and image sensor 12. Image sensor 12 is of the Charge Coupled Device (CCD) type. The zoom lens 9 provides a variable level of magnification or zoom of the image projected onto the image sensor 12. As the level of magnification is increased, the field of view on the page decreases. The image acquired by the camera is processed by circuitry located in head unit 2, and then displayed on VDU 1. The camera may be a colour or monochrome model, the latter being used in

low cost video magnifiers. A light source (not shown in Figure 1) is located in head unit 2 and shines down onto X-Y table 5 to illuminate the source material.

User controls 10 are usually found on the front panel. A large zoom knob allows the user to increase and decrease the level of magnification from typically 3x to 45x. Older models have a manual focus knob while more recent models use a motorised auto-focus system. Another control often found on the front panel allows the user to select a viewing mode. These modes include photo, text, false colour, and inverse colour modes. The photo mode simply displays the scanned objects on the VDU 1 without implementing any image processing, text mode enhances the image by using pixel level threshold filtering, false colour mode allows for easier reading of text by changing the scanned colours to colours that are easier to read and the inverse colour mode allows for inversion of text and background colour to decrease image intensity and thus reduce eye strain. This list of features is by no means exhaustive of the features that could be incorporated into a video viewing system.

To use the prior art video magnifier, as described above, the user needs to place the source material face up on X-Y table 5. Part of the source material will be magnified on the VDU 1, when reading the text the user then needs to move the X-Y table 5 to the left and right while their eye follows the text. Moving the X-Y table 5 in this way can be tiring for the user's arms and their eyes. Scanning the viewing area across the text takes a great deal of concentration that could be better utilised for reading and comprehension. This movement also requires a certain level of coordination and dexterity that is often absent in elderly people. An example of this type of invention is disclosed in US Patent No 3 819 855.

WO 00/36839 discloses an upward facing source material low vision viewer utilising a video camera. The camera is mounted on a stand above the source material and can view the entire page or view selected sections of the page by the camera lens pointing down from the stand and being moveable by hand. This requires a high level of dexterity from the user.

A related form of high-resolution face up scanner is used in museums and the like for scanning manuscripts. This is performed face up due to the delicate nature of such documents. Such scanners use linear sensors that are scanned across the image of the

page. US 5 616 914 is an example of such a device.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a viewing device to allow persons of low-vision the ability to view small objects that goes some way to overcoming the abovementioned disadvantages in the prior art or which will at least provide the public with a useful choice.

Accordingly in a first aspect of the present invention may broadly be said to consist in an apparatus for low-vision users that displays the image of an object, said apparatus comprising:

a camera, including a lens to define an image plane and an electronic image sensor located at the image plane for capturing a visual field;

a display means;

an electronic processing means connected intermediate of said display means and said camera, and that defines said visual field as a set of pixels and a subset of said set of pixels as a window-of-interest and a steering means to select said subset of pixels on said visual field which constitutes the window-of-interest.

Preferably said electronic image sensor is a high-resolution image sensor that captures a high-resolution visual field image.

Alternately said electronic image sensor is a low-resolution image sensor that captures a plurality of low-resolution visual field images by moving a low-resolution image sensor by sub-pixel amounts and combining said low-resolution visual field images to create said high-resolution image.

Alternately said electronic image sensor consists of a plurality of low-resolution image sensors that are optically "butted" together to create a single high-resolution image sensor and captures said high-resolution image.

Alternately said electronic image sensor is a low-resolution image sensor that is moved within said image plane of said lens to capture a plurality of low-resolution visual field images and combining said low-resolution visual field images to create said high-resolution image.

Preferably said electronic processing means moves said window-of-interest on said high-resolution image sensor by reading said subset of pixels from said high-resolution

image sensor and displaying said subset of pixels on said display means.

Alternately said electronic processing means moves said high-resolution image sensor within said image plane of said lens and displays said window-of-interest or said high-resolution visual field image on said display means.

Preferably said low-vision user controls location of said window-of-interest or said high-resolution image sensor by one device from the group consisting of a trackball, a joystick, a set of buttons, a mouse, a touch screen, a touch tablet.

Preferably said electronic processing means subsamples said window-of-interest by reading said subset of pixels as defined by a previously defined regular pattern and displays compressed image on said display means.

Alternately said electronic processing means subsamples said high-resolution visual field image by reading said set of pixels as defined by a previously defined regular pattern and displays said compressed image on said display means.

Preferably said electronic processing means is controlled by a software program that applies digital magnification to said high-resolution visual field compressed image, said window-of-interest image, or said window-of-interest compressed image to desired magnification level selected by said low-vision user and displays the digitally magnified image on said display means.

Preferably said electronic processing means is controlled by a software program that magnifies said image of said object and displays said image on said display means.

Preferably said electronic processing means is controlled by a software program that selects said high-resolution visual field compressed image, said window-of-interest, or said window-of-interest compressed image based on said desired level of magnification selected by said low-vision user, and displays selected image on said display means.

Alternately said desired magnification level is selected by said software program in said processing means so that text that is viewed is magnified to a preselected size on said display.

Preferably said digital magnification is implemented by said processing means where a monofocal lens is used.

Preferably said digital magnification is implemented using two dimensional scaling with one form of interpolation selected from the group consisting of linear interpolation,

nearest-neighbour interpolation, cubic spline interpolation.

Preferably said electronic processing means is controlled by a software program that automatically adjusts the brightness and contrast of said high-resolution visual field compressed image or said window-of-interest or said window-of-interest compressed image on said display.

Alternately said image brightness and contrast on said display is manually adjusted.

Preferably said electronic processing means includes storage means to store and replay said high-resolution visual field compressed image, said window-of-interest, or said window-of-interest compressed image.

Preferably said apparatus includes supporting means for said camera.

Preferably said supporting means holds said camera so said lens is below said electronic image sensor said object faces upwards towards said camera.

Preferably said camera includes a light source to illuminate said object.

Preferably said apparatus for low-vision users further comprises:

a camera, including a lens to define an image plane and an electronic image sensor located at the image plane for capturing a visual field;

a display means;

electronic processing and storage means connected intermediate of said display means and said camera, and that defines said visual field as a set of pixels and stores said set of pixels; and

said electronic processing means controlled by a software program that applies digital magnification to said stored set of pixels to desired magnification level selected by said low-vision user and displays magnified visual field image on said display means.

Preferably said storage means is sufficiently large to store a plurality of said high-resolution visual field images.

Preferably said electronic processing means includes position control means that allow the user to move the viewing position of said stored high-resolution visual field image that is displayed on said display by reading subsets of said set of pixels from said storage means.

Preferably said electronic processing means is controlled by a software program that automatically adjusts the brightness and contrast of said high-resolution visual field

image on said display.

Preferably said electronic processing means is controlled by a software program that implements pixel level binarisation on said stored high-resolution visual field image based on a uniform pixel threshold level.

Alternately said electronic processing means is controlled by a software program that implements pixel level binarisation based on a pixel threshold level which varies over said high-resolution visual field image to provide optimum binarisation in the presence of brightness variations.

Preferably said electronic processing means is controlled by a software program that determines the orientation of said high-resolution visual field image, if said high-resolution visual field image contains text, rotates and aligns said image so said text is vertical and upright on said display.

Preferably said electronic processing means is controlled by a software program that determines if said high-resolution visual field image of said object is not flat, maps said high-resolution visual field image and aligns any lines of text on said image into a horizontal and flat orientation.

Preferably said electronic processing means is controlled by a software program that maps said high-resolution visual field image to remove distortion caused by said lens.

Preferably said electronic processing means is controlled by a software program that maps said high-resolution visual field image to remove perspective caused by the distance and angle between said lens and said object.

Preferably said electronic processing means and storage means is controlled by a software program where said text is recognised utilising optical character recognition and said text is converted into formatted or unformatted ASCII text.

Preferably said ASCII text is stored in said storage means.

Preferably said ASCII text is converted into text of any user specified typeface.

Preferably said electronic processing means is controlled by a software program that is able to identify letters in said stored high-resolution visual image text and display said letters on said display.

Preferably said software program that arranges said letters into words and then displays said words on said display means in a sequence that each said word replaces

previous said word after a user selected period of time.

Alternately said software program that arranges said words to be displayed on said display means in a sequence from one side of said display means to another side of said display means and forming a new sequence of said words below the previous sequence of said words once said software program instructs.

This invention may also be said broadly to consist in the parts, elements and features referred to or indicated in the specification of the application, individually or collectively, and any or all combinations of any two or more of said parts, elements or features, and where specific integers are mentioned herein which have known equivalents in the art to which this invention relates, such known equivalents are deemed to be incorporated herein as if individually set forth.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a side elevation illustrating a video magnifier representative of the prior art;

Figure 2 is a side elevation illustrating the preferred embodiment of the invention;

Figure 3 illustrates an image being imaged by the lens onto the image sensor as an object of the preferred embodiment of the present invention;

Figure 4a illustrates the image seen on the image sensor in full-scan mode;

Figure 4b illustrates the image as captured and stored by processing module 22 in full-scan mode;

Figure 5a illustrates the image seen on the image sensor and the window-of-interest in the window mode;

Figure 5b illustrates the image displayed on the VDU in window mode;

Figure 6a illustrates the image seen on the image sensor in subsampling mode;

Figure 6b illustrates the image as displayed on the VDU in subsampling mode;

Figure 7a illustrates the image seen on the image sensor and window-of-interest in hybrid mode;

Figure 7b illustrates the image as displayed on the VDU in hybrid mode.

Figure 8 illustrates the flow of the software used for controlling the video magnifier system.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present low-vision viewer magnifies the face-up source material in the visual field of the camera and displays the magnified image on a VDU or other display means. There are two different camera modes. The static camera capture mode 53 captures and stores the image of the source material with high-resolution. This high-resolution image can be manipulated and displayed on the display means. The live video capture mode 52 captures lower resolution images at a high frame rate to give full motion video. In live capture mode the low-vision user can move the view around the source material and zoom in on a desired section of interest. The same camera and the same apparatus is able to be used in either static or live modes.

The static camera capture mode 53 provides the software controlling the system with a high-resolution image. This allows precise pixel data to be obtained from the image and manipulated for optimum viewing for the low-vision user. Forms of manipulation include changing the orientation of the source material, or the method of displaying of characters on the display. Further manipulation of the image sensor data is performed with Optical Character Recognition (OCR). This can provide the advantage of extending the utility of the magnifier for poor or no vision users by generating an output in Braille or speech.

The live video capture mode 52 requires a level of magnification to be selected by the user. The possibilities are a low magnification (subsample mode) 37, medium magnification (hybrid mode) 38 and high magnification (window mode) 39. To smoothly change between these magnification levels, or modes, a digital zoom is implemented 40. The digital zoom increases the magnification of the image using linear scaling and interpolation. The image can be manipulated to increase readability by using contrast enhancement and false colours 41.

Physical Structure

Figure 2 depicts the preferred embodiment of the present invention of a face-up low-vision magnifier system. The source material 13 is placed on the base 14 facing upwards towards the camera head 15. Camera 15 is held above the source material 13 by the arm 16. This arm 16 may be fixed or adjustable. Image sensor 18 is in vertical alignment with lens 17, both being enclosed within the camera 15. The light reflected from the source material 13 is focussed by lens 17 and forms an image of the source

material 13 on the image sensor 18. The image captured by image sensor 18 is then transmitted to module 22 for processing for output to the display for low vision users. The module 22 processes the captured image and the resulting digital image is conveyed to the low-vision user by the display or speakers (not shown).

The software program and associated hardware for controlling the video magnifier is located in the processing module 22. The control processes for the video magnifier are illustrated in Figure 8.

The camera 15 can be mounted in some alternative ways. Typically the camera 15 is mounted above the source material 13, with its field of vision of lens 17 aimed at the upward facing source material 13. Alternately, the camera 15 may be adjusted by the user to a variety of angles allowing for acquisition of images that are sideways or are at a distance from the camera 15. The camera 15 in the preferred embodiment consists of one camera with two different acquisition modes 35, the first being a static image camera mode 53 and the second being a live image camera mode 52. The static camera mode takes a high-resolution picture, for example a still-life camera, and the live camera mode takes numerous low quality pictures, for example a video camera. In an alternative embodiment, two cameras would be used, one for static capture and the other for live video capture. These cameras will have the same function as the modes as stated above. In addition a live camera could be located remotely from the static image capture system but attached by a cable to capture images from a distant object.

Lens 17 may be of the adjustable zoom type, but preferably a single focal length lens to reduce system complexity and cost. The aperture of lens 17 is normally automatically adjusted but may also be fixed or manually adjustable to achieve optimum image brightness and depth of focus. Similarly, the focus adjustment is normally automatic but in an alternative embodiment is fixed or manually adjusted.

Image Sensor

In the preferred embodiment the image sensor 18 is composed of a single high-resolution image sensor, alternatively it consists of a plurality of low-resolution image sensors. These low-resolution image sensors are optically "butted" together to form a single high-resolution image sensor. In another alternate embodiment, the system consists of a low-resolution image sensor that is "micro scanned" to increase its individual

resolution. Micro scanning involves moving the image sensor 18 by sub-pixel amounts and acquiring images at different positions. The different images are combined to form a single high-resolution image.

In an alternate embodiment of the present invention the high-resolution image sensor 18 comprises a low-resolution sensor that is smaller than the image plane 18, and the low-resolution sensor is mechanically moved around the image plane 18 to capture various parts of the image. These low-resolution image sections can then be joined together to form a single high-resolution image covering the whole image 18 of the source material.

Image sensor 18 is preferably of the Complementary Metal Oxide Semiconductor (CMOS) type, alternatively it may be of the CCD type. The CMOS image sensor has two main advantages over the CCD image sensor. The CMOS image sensor is made from standard fabrication processes so allowing for lower production costs and it has the ability to read the pixels on the sensor in any sequence compared to the CCD image sensor where pixels must be read in a sequential order. It is preferable to use a CMOS type image sensor as we are able to read pixels in any sequence allowing one camera to have both static and live acquisition modes. This allows for a lower cost system compared to using separate purpose cameras. The reading of pixels in any sequence leads to a plurality of sensor read out modes.

Image Capture Modes

Figure 3 further illustrates the layout of the visual field and the components associated with directly viewing the source material. Light from the full image 13 of the source material passes through lens 17 and onto the full light-sensitive area of sensor 18. The scanned image 13 rotates 180 degrees as it passes through lens 17.

Reading the pixels from the image sensor 18 in different sequences allows for different read out modes. The static image capture mode 53 is shown in Figure 4 and live capture modes 52 are shown in Figures 5 to 8. The viewing system for each mode is arranged as in Figure 3. All the images seen in Figures 5b, 6b and 7b are magnified to cover the entire viewing area of the display.

Figures 4a and 4b show the full-scan read out mode 43, this gives a high-resolution image and is only used when in the static image capture mode 53. This occurs when all

the data from the image sensor 18 is read out from the sensor and stored in module 22, where it can be processed and displayed on the display. Figure 4a shows the entire picture 23 being read in by the image sensor 18, which also has the same view as the lens 17. The entire image 24 as seen in Figure 4b is then processed and can be displayed. The image sensor 18 is a high-resolution image sensor and all of its pixels are read out, this results in a picture with a lot of detail and a low frame rate. The image takes a long time to read out due to the limited data readout rate from the image sensor 18 and the large amount of data being read out. This produces a high quality static picture of the image.

The windowing mode 39 is illustrated in Figure 5a and 5b. Figure 5a shows the desired window-of-interest 26 on the full image 25 as seen by image sensor 18. The window-of-interest 26 on image sensor 18 is read out and displayed 27 on the display means (Figure 5b). The image 27 produced is of the same quality as the full-scan image but smaller, thus giving an increased frame rate. The frame rate is increased by reducing the number of pixels read per frame while maintaining the pixel readout rate. The user can move the window-of-interest 26 using a hand control or similar device (not shown). This allows the user to scroll around the image in real time. Windowing mode gives a high level of magnification 39.

The subsample mode 37 is illustrated in Figure 6a and 6b. The image 29 displayed on the display is a less detailed view of the full image 28 seen by the image sensor 18. Certain pixels, for example every second pixel, are skipped while reading pixels out of the image sensor so the image acquired 29 is smaller and has a reduced resolution. The number of pixels read out per frame is less than the full-scan mode thus allowing for an increased frame rate. Subsample mode 37 allows for an increased frame rate while producing a full-page overview with reduced detail. This is a good way to preview the full-page image. Subsample mode gives a low level of magnification 37.

The subsample 37 and windowing 39 modes may be combined to produce a hybrid mode 38, as illustrated in Figures 7a and 7b. In this hybrid mode 38 the window-of-interest 30 is larger than the window-of-interest in the windowing mode 39 and when the data is read out certain pixels are skipped, similar to the subsample mode 37. The hybrid mode allows for a high frame rate while viewing an area of interest that is larger than the windowing mode view 39 and smaller than the subsample mode 37.

Hybrid mode gives a medium level of magnification 38.

The windowing 39, subsample 37, and hybrid modes 38 allow us to image either a full page or parts of the page and provide several different levels of magnification at a high frame rate. The high frame rate means the images acquired are live video and the different levels of magnification are performed without the use of a zoom lens. To allow a smooth transition between these discrete magnification levels, and to provide a higher magnification than what is provided in windowing mode 39, a digital zoom is used 40.

Digital Zoom

In the preferred embodiment of the invention different pixel read out modes (windowing 39, subsample 37 and hybrid modes 38) are used in conjunction with a digital zoom 40 to duplicate the operation of a traditional zoom lens based system. This allows the invention to use a monofocal lens as opposed to a zoom lens. This makes the low-vision video magnifier camera assembly smaller, lighter, more reliable and it potentially costs less to manufacture.

The digital zoom 40 magnifies the image displayed on the display by an arbitrary amount, as specified by the user, by using two-dimensional linear scaling with interpolation. The type of interpolation is preferably linear but it could also be nearest-neighbour or cubic spline interpolation.

The full operation of live video capture mode 52 can now be described. The user will select a desired level of magnification. Each of the three sensor readout modes (subsample 37, hybrid 38 or windowing 39 modes) corresponds to a certain level of magnification. Module 22 selects the readout mode 37, 38 or 39 for image sensor 18 that has the highest level of magnification that does not exceed the level selected by the user. If the magnification provided by the readout mode is still below the user-selected level, then digital zoom 40 is used to magnify the image up to the desired level.

Image Processing

Image processing may be performed in both live 52 and static capture 53 modes because both modes provide a digital output. The high- and low-resolution digital images in the preferred embodiment of the present invention are then digitally processed and enhanced to improve readability and comprehension for the low-vision viewer.

In static 53 and live video mode 52 there are several forms of image manipulation

41 of the live video low-resolution image available to the user. These include applying contrast enhancement, binarisation, and false colours to the image displayed on the display means.

Text Processing

In static mode 53 the high-resolution image may be manipulated in many different ways. For example, the whole or parts of the image could be automatically rotated 90 or 180 degrees to cope with upside-down or landscape formatted documents, 44. This is an important feature as low vision users may not be able to tell the orientation of a document without magnification. The image could also be deskewed 44 by rotating the image slightly to straighten it. This is important as with a face-up video magnifier it may not be easy for the user to determine the visual field of the camera, and therefore the document can easily be misaligned. Another problem is curvature of the document; this is when the source material does not lie flat on base 14. The text can be straightened by texture mapping 44.

Problems tend to occur when capturing a whole page image; these are image distortions such as barrel distortion. This results from using a wide-angle lens to capture an entire image of the source material. This can be removed by using a lens-correcting algorithm 44, for example barrel-to-square compensation.

The low-vision user is able to select from a number of different viewing modes. These viewing modes consist of the image displayed following the lines of text on the source material. The electronic processing means 22 are able to determine where the text elements are located on the stored image and creates a copy of the text elements, applies digital magnification, and arranges the text elements on the display in the user specified display format.

Image Manipulation

Digital Zoom 46 is implemented to magnify the pictures and text to the desired size. The user may select the level of magnification that is desired, or the level of magnification may automatically be chosen so that all text appears at the same size.
The simplest way 47 of displaying the high-resolution image obtained from the full-scan mode 43 is to display it on the screen directly. In most cases the image will be larger than the display screen resolution, so only part of it will fit on the screen. The digital zoom

function 46 allows the user to move the viewing area around the full image and digitally zoom in and out of the image.

The simple image display mode 47 may not be the optimum display mode for all low-vision users. For instance, an eye condition may limit the useable field of view, in this situation it would help if all words appeared in the same position for viewing. It would be advantageous to be able to recognise the areas of an image that represent word or letters and then rearrange these on the screen. In this way words or letters could be displayed in other text display formats 48. Other text formats can be achieved simply by recognising text (letters and words) and pictures in the image, copying the text and pictures out of the digital page image, scaling them to the required size, and then displaying them on the screen in the required format.

One alternative display format 48 will have letters and words being pasted onto the screen from left to right, wrapping around the width of the screen as the user scrolls up and down the text. Another screen format 48 is when a single or a plurality of words are flashed up on the screen in the same place at an adjustable rate. In yet another screen format 48 the text scrolls horizontally past the user on the screen. In any of these screen formats, the user is able to adjust the spacing between letters and the character size (using digital zoom 46) as this can increase readability, comprehension and reading endurance. It would also be advantageous to automatically scale the text so that all characters are displayed at the height for optimum readability by the user, regardless of the original character size.

The main disadvantage of image display modes 47 and 48 are that the character viewing quality is not improved. Increasing the magnification using digital zoom 46 magnifies any imperfections in the original scanned characters. Another disadvantage is the inability to alter the typeface of the characters to one that is easier for the user to read. OCR offers solution to these abovementioned problems.

OCR

In the present invention the high-resolution digital image is processed using OCR 49 to provide improved text presentation formats for the user. OCR has the ability to recognise the characters in an image and provide an output form such as formatted or unformatted ASCII 50. This provides a wider flexibility over the current presentation

format on the display. All the previously mentioned modes of text presentation 47, 48 can be extended to use the ASCII characters from OCR. These characters can be rendered 51 on the display using a clean typeface or in a different typeface to provide ease of reading, and then displayed 54 in any of the previously described display formats.

Display modes for the ASCII text or the OCR text consists of the user specifying a viewing typeface and the text is changed to this selected typeface. Another display mode consists of arranging the letters in sequence on the display from left to right, upon reaching the right-hand side of the screen, forming a new line below the newly completed line. The user may then scroll up and down this screen. Alternately, the text may continue in one long line across the screen and the low-vision user may scroll across the screen to view all the words. Yet another display mode is to display single words on the screen in sequence. Each word is displayed on the screen for a specified period of time and then the next word replaces it on the screen.

The ASCII data 50 resulting from the OCR 49 recognising text can be stored with much less memory than storing the original image. This makes the data versatile for transmitting, storing and editing. Alternately this data could be translated into Braille 33 for display on a Braille cell or translated to speech 34 to be used by a speech synthesiser 36. These alternate embodiments expand the utility of the video magnifier to those of very poor vision or no vision.

DATED THIS 28 DAY OF March 2002
AJ PARK
PER Herbert
AGENTS FOR THE APPLICANT

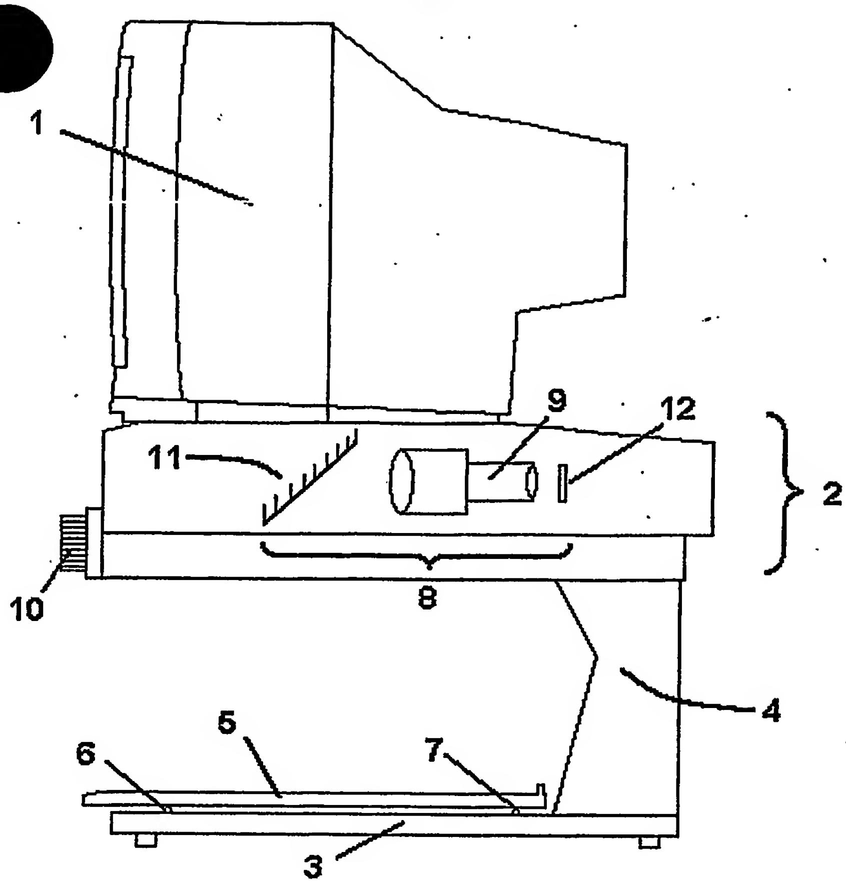


Figure 1

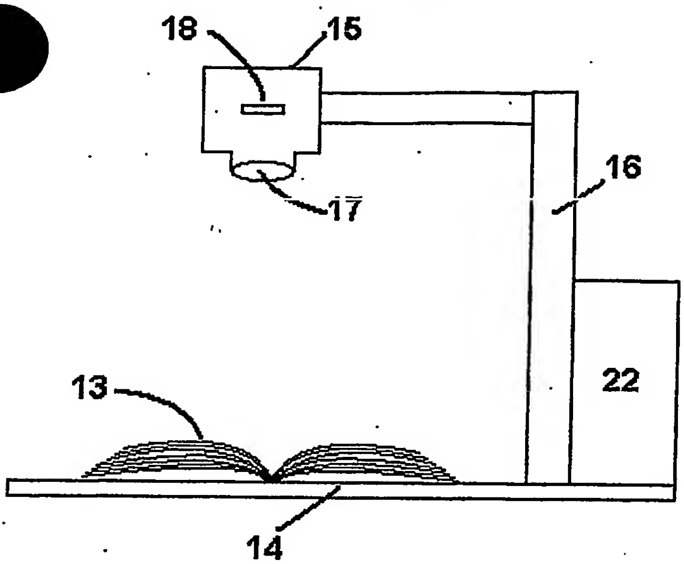


Figure 2

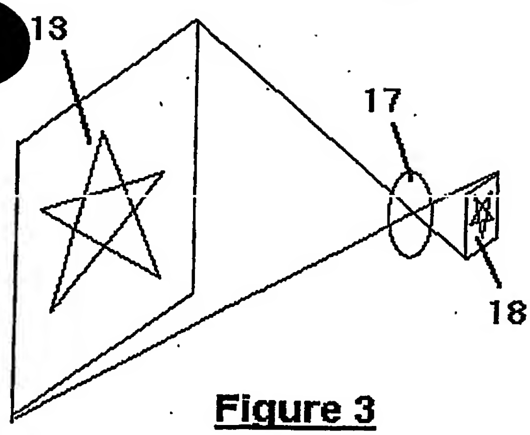


Figure 3

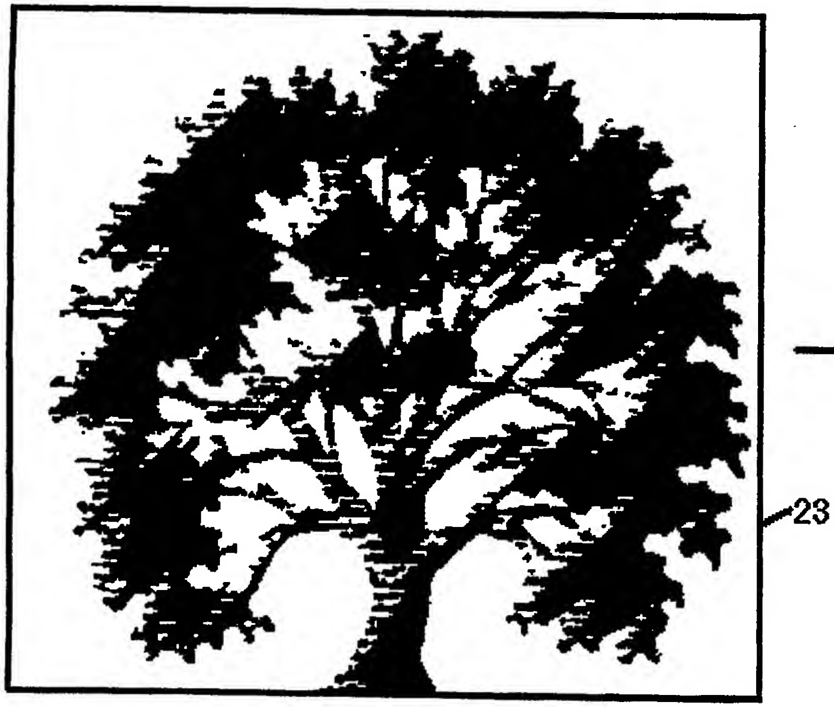


Figure 4a

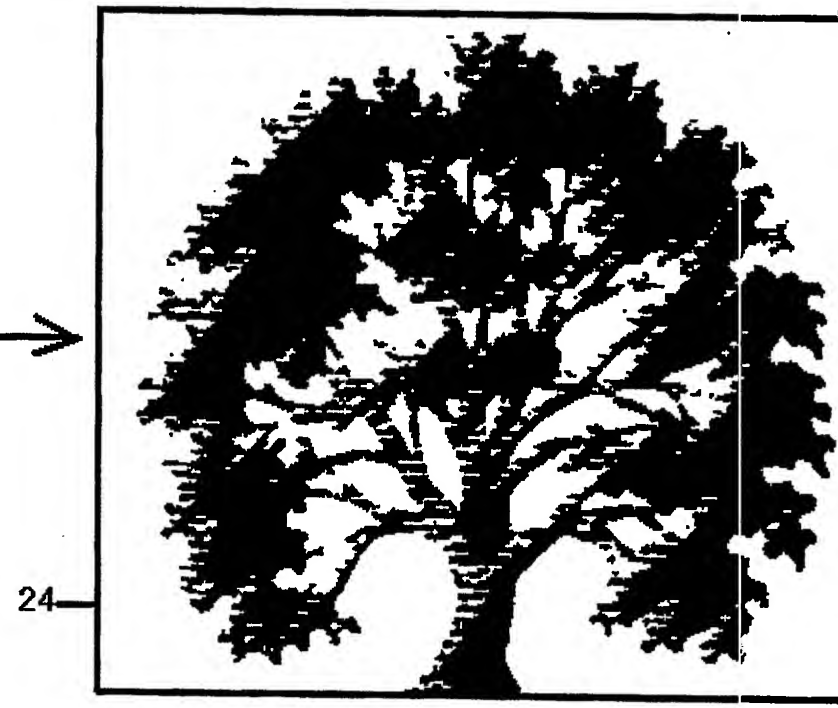


Figure 4b

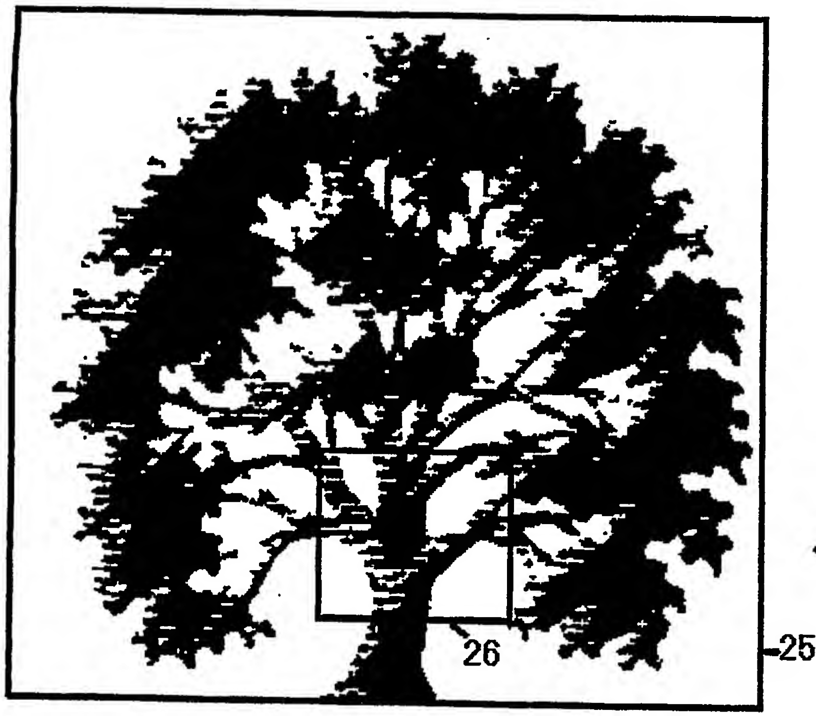


Figure 5a

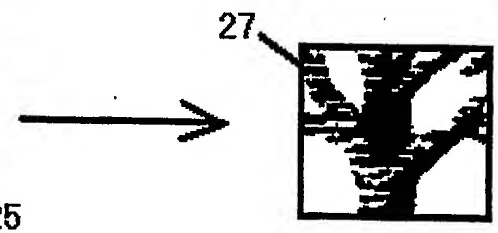


Figure 5b

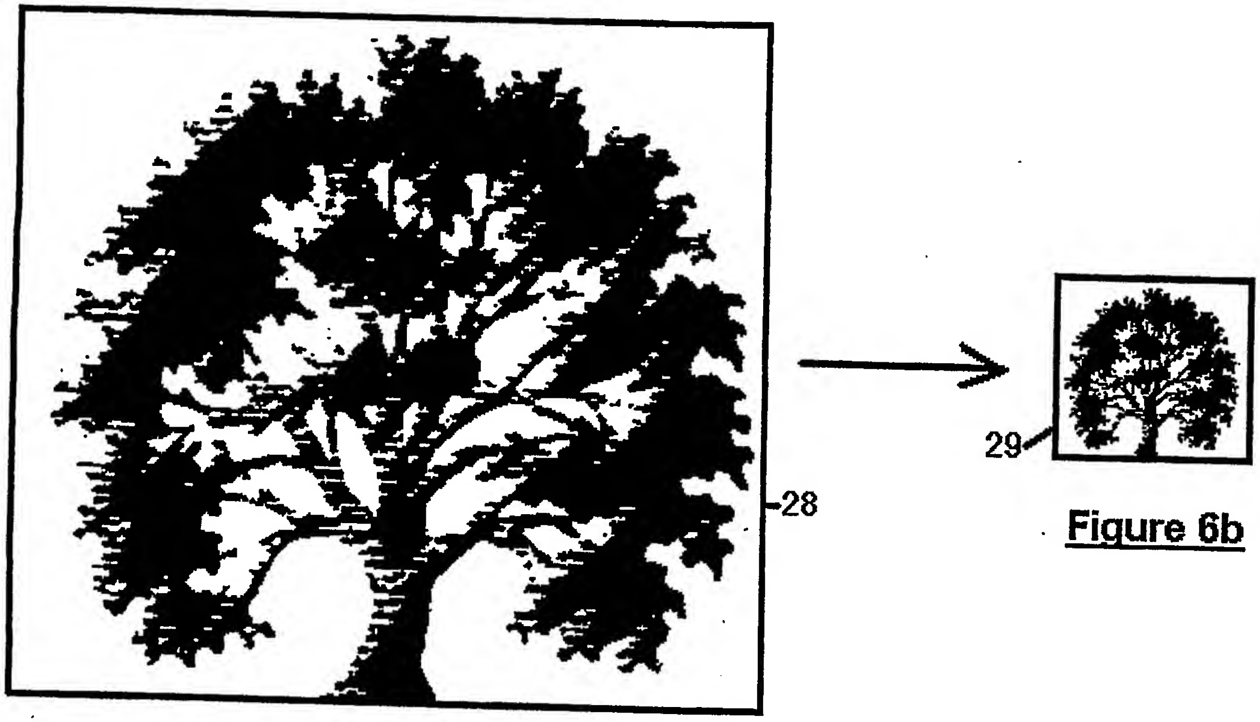


Figure 6a

Figure 6b

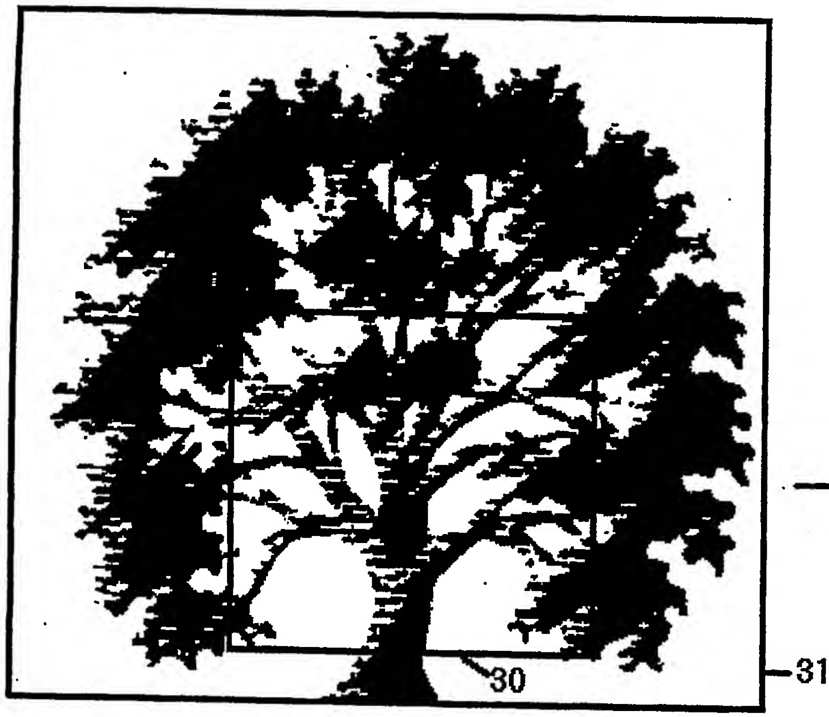


Figure 7a

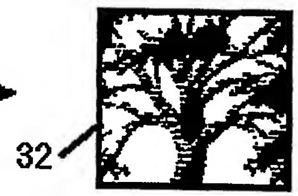
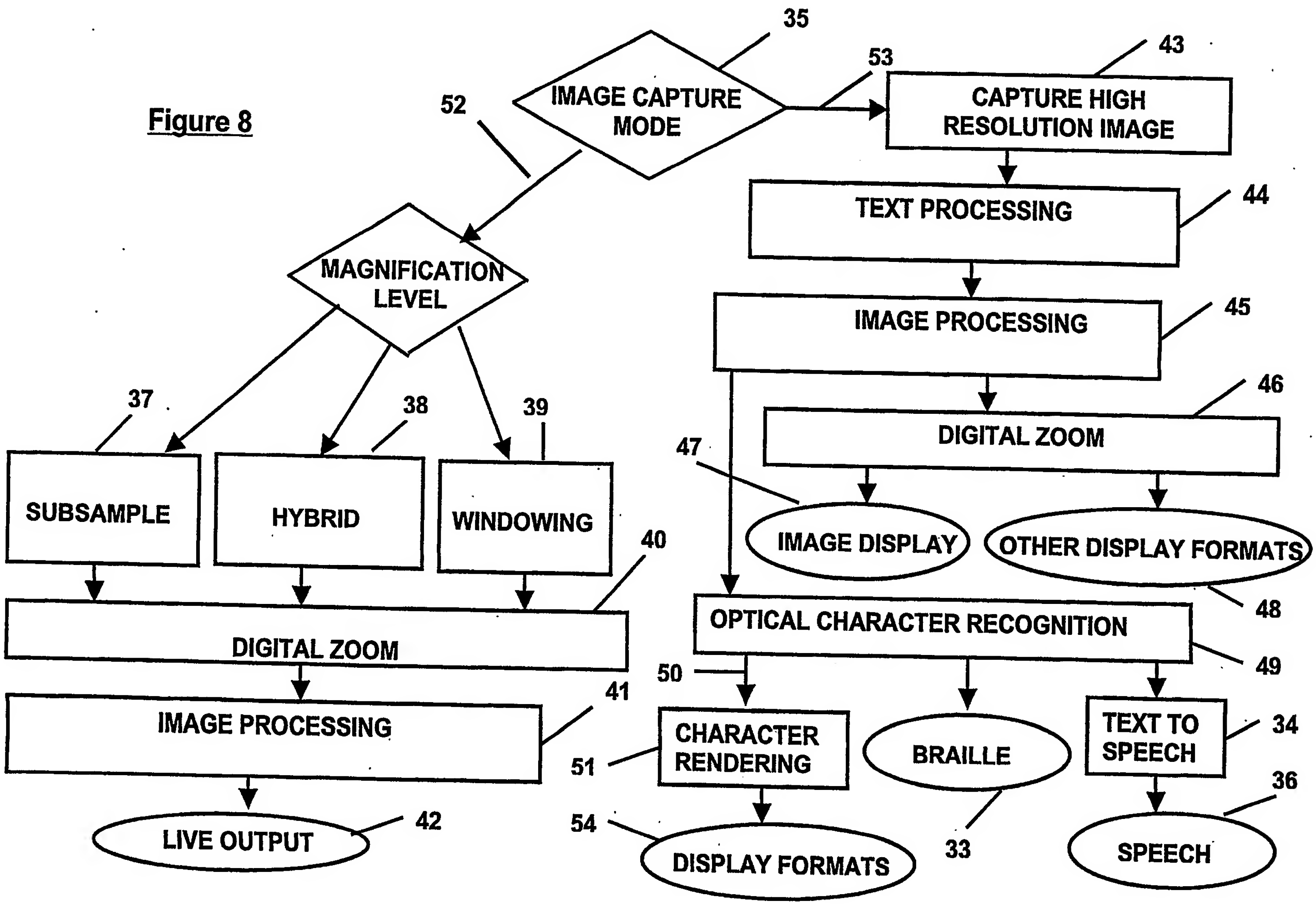


Figure 7b

Figure 8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52
53
CAPTURE HIGH RESOLUTION IMAGE
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TEXT PROCESSING
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IMAGE PROCESSING
45
DIGITAL ZOOM
46
IMAGE DISPLAY
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OTHER DISPLAY FORMATS
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OPTICAL CHARACTER RECOGNITION
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CHARACTER RENDERING
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DISPLAY FORMATS
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TEXT TO SPEECH
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SPEECH
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MAGNIFICATION LEVEL
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IMAGE PROCESSING
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LIVE OUTPUT
42

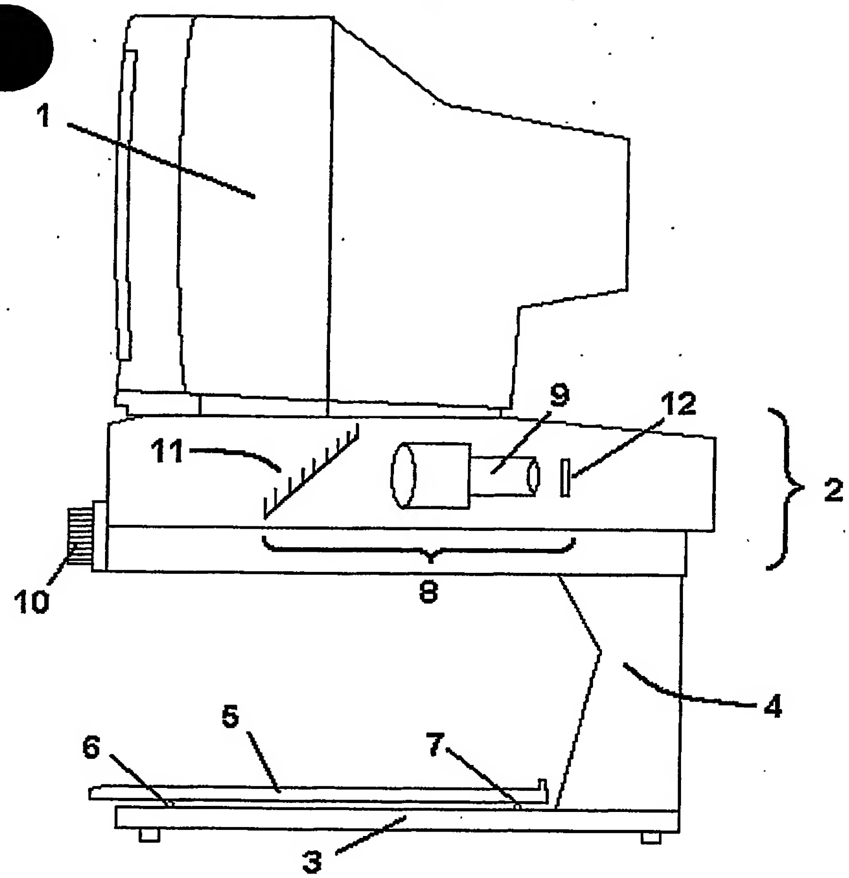
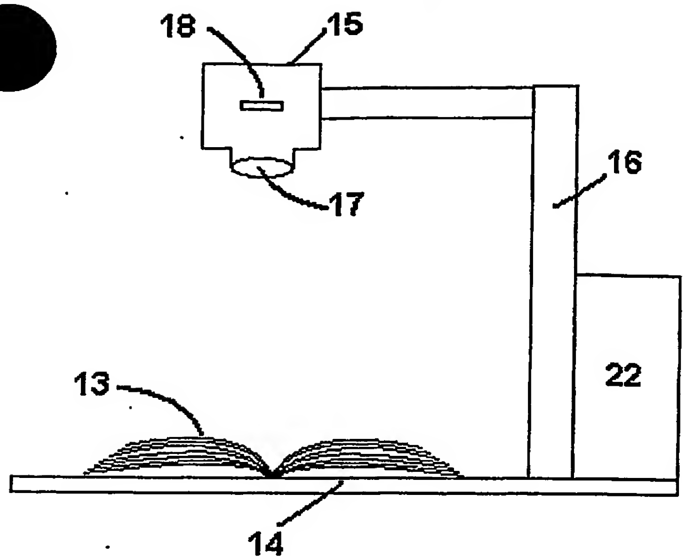


Figure 1



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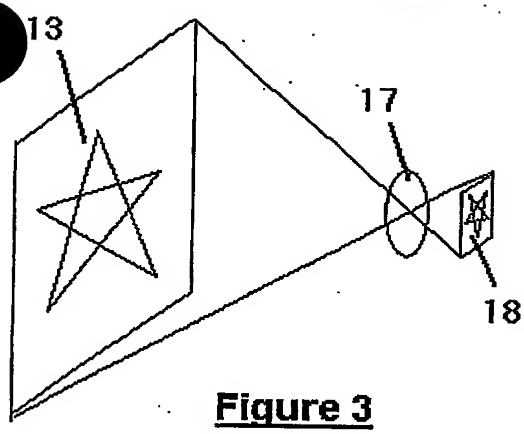

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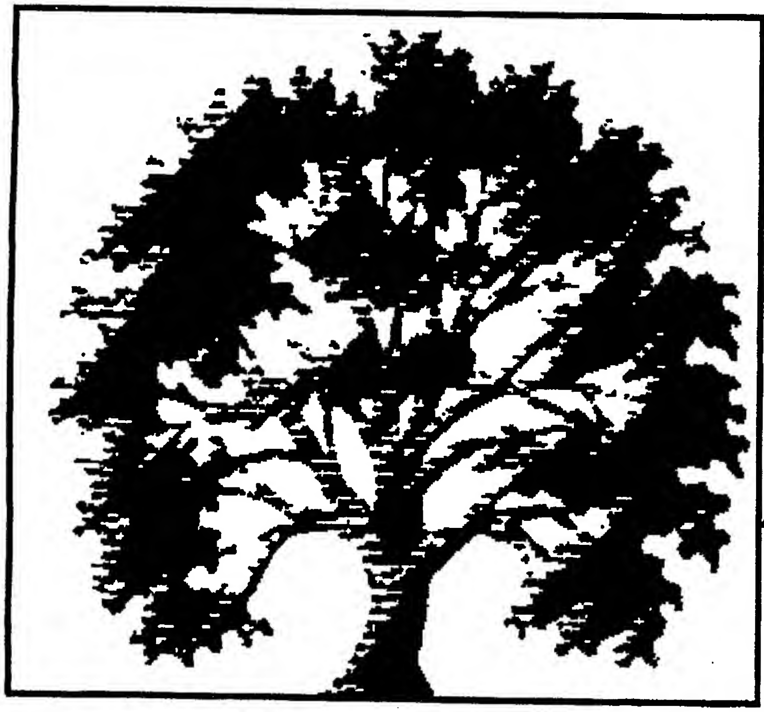


Figure 4a

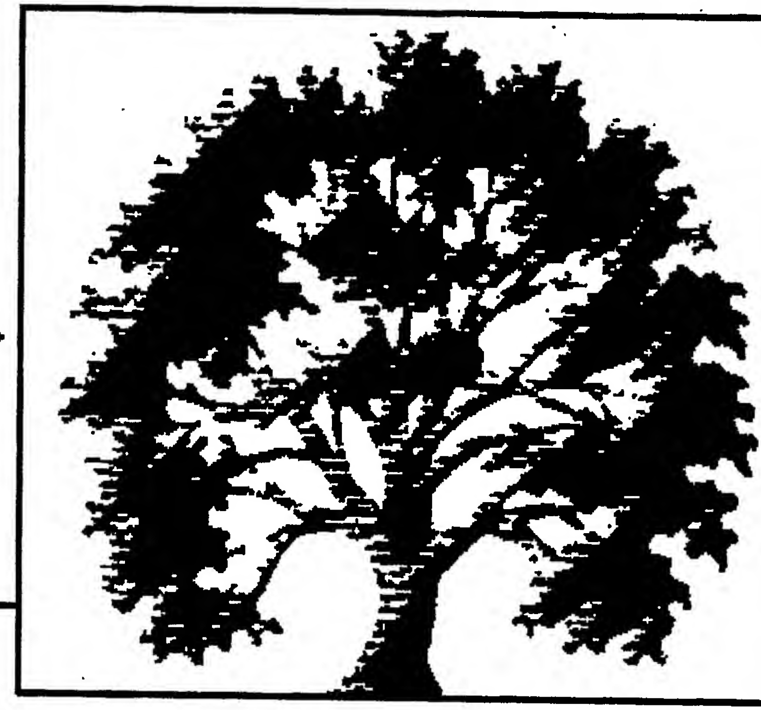


Figure 4b

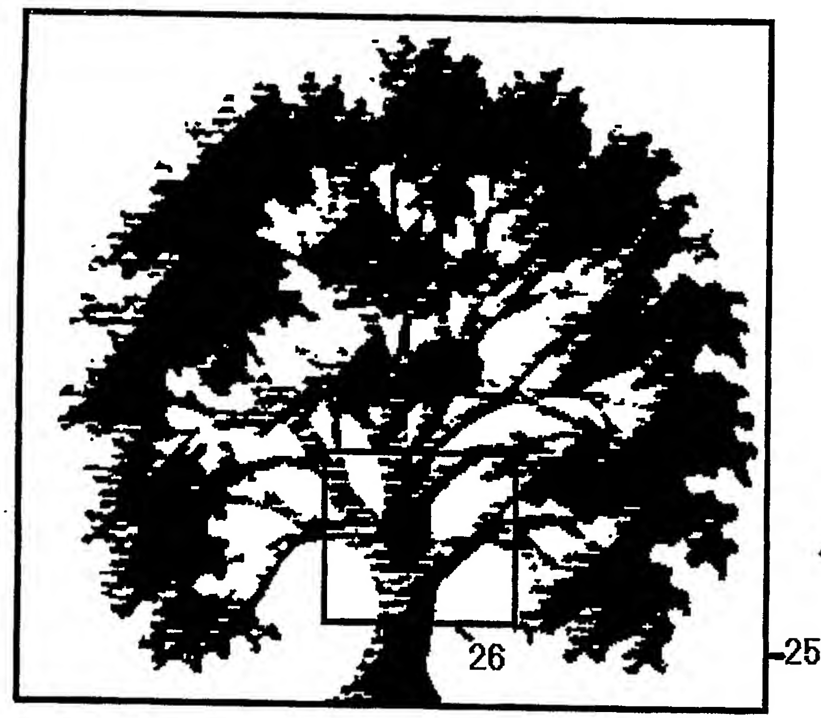


Figure 5a

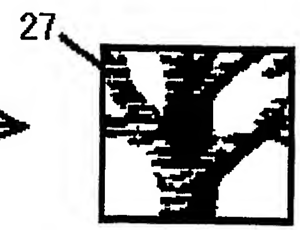


Figure 5b

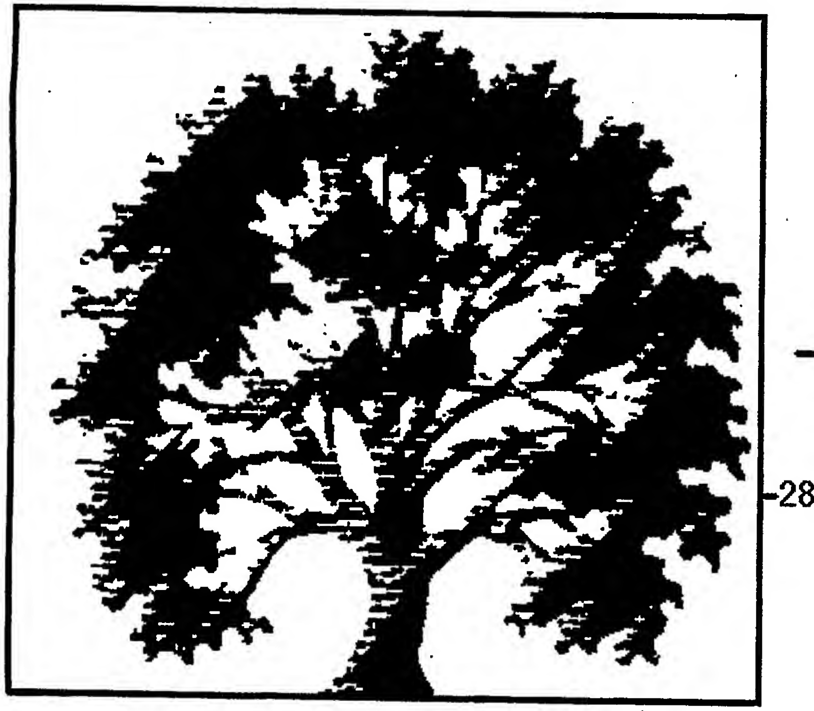


Figure 6a

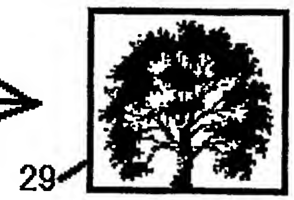


Figure 6b

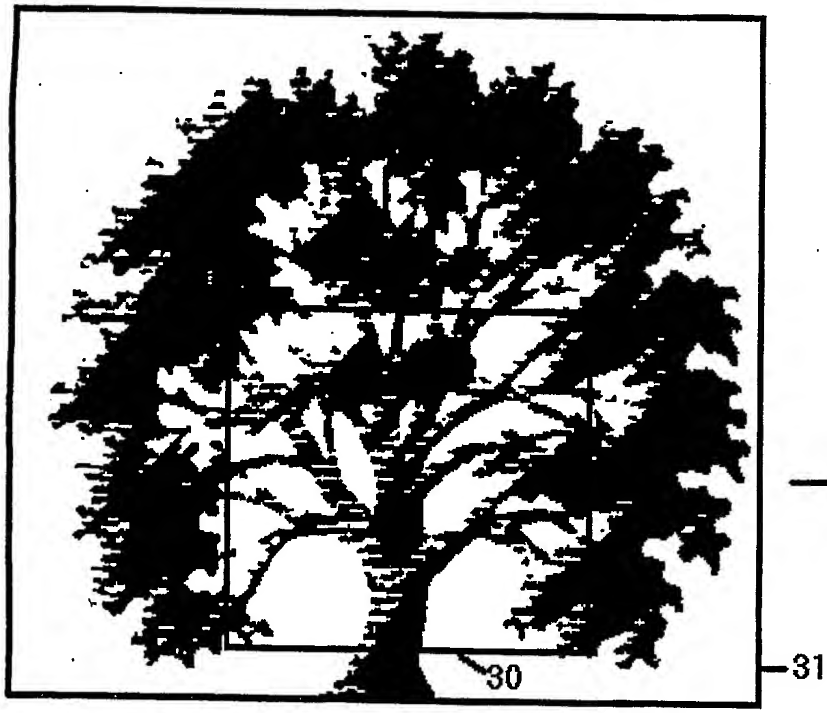


Figure 7a

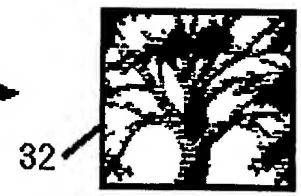
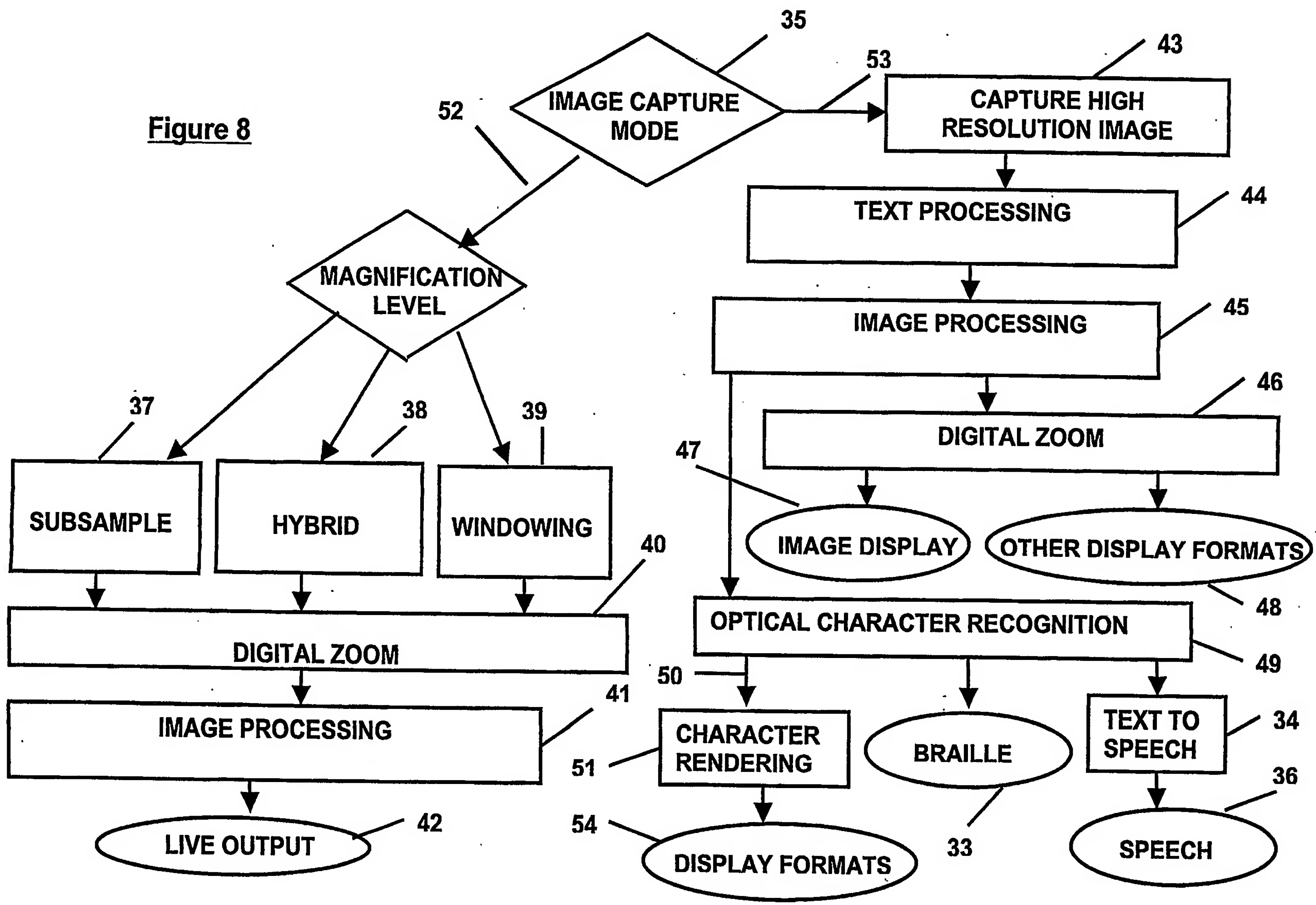


Figure 7b

Figure 8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